WILD FIRE MANAGEMENT IN CONSERVATION RESERVES[1]

INTRODUCTION

Implementation of the Placer County Conservation Plan (PCCP) will result in the permanent protection of approximately 50,000 acres in conservation reserves by the year 2060 (Figure 1). Preservation of these lands in perpetuity will require that they be managed to reduce their susceptibility to wild fire. In the event that a fire occurs within a conservation reserve, there is also a concern to reduce potential damage due to suppression activities.

This document contains policies, procedures and prescriptions for managing wild fire risk in conservation reserves primarily through treatment of fuels. Further, it recommends that each reserve have a fire management component included within a PCCP-mandated management plan. The fire management component should describe site-specific conditions and actions required to: 1) reduce existing fuel loads; 2) re-introduce fire as a natural process of the ecosystem (if relevant); 3) minimize environmental impacts and protect sensitive resources; and 4) enhance and/or restore natural community characteristics. The emphasis of this document is on fuels treatments. Addendum 1 discusses the impacts that fire suppression actions can have once a fire starts. It describes approaches to minimize those impacts in conservation reserves.

APPLICABILITY

These guidelines apply to conservation reserves that are either owned by or that have conservation easements held by the PCCP implementing entity. Within those lands, vegetation management will be a covered activity under the PCCP. For conservation reserves managed by other entities such as land trusts, the guidelines are advisory only. For private lands within the PCCP planning area that are not within conservation reserves, the guidelines are also advisory.

EXISTING COUNTY POLICIES AND ORDINANCES

Placer County General Plan

The Placer County General Plan provides very limited policy guidance in regard to wild fire management. It was adopted in 1994 when public awareness of wild fire impacts in the "wildland-urban interface" was not as acute as it is today. It advocates the use of

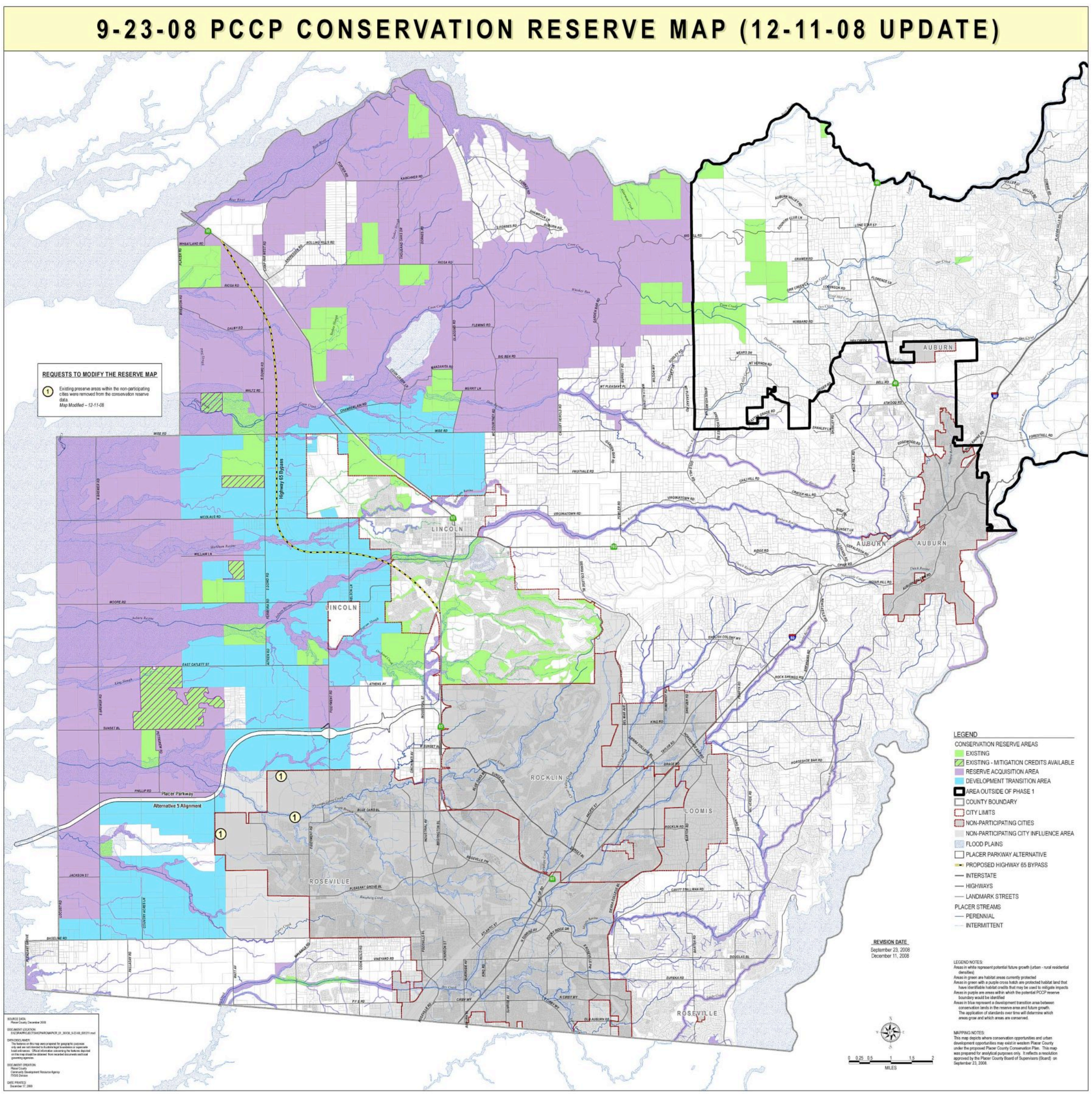
[1] The term conservation reserve is used here to define lands acquired in fee or permanently protected within conservation easements as a result of PCCP implementation. These lands may be privately owned and managed but subject to the terms of a conservation easement held by the PCCP implementation entity.

prescribed fire for environmental management but provides no guidance on where that should occur.

Placer County Tree Ordinance

The Placer County Tree Ordinance regulates tree removal in defined tree preservation zones or when a discretionary permit approval is required for a project. The Tree Ordinance provides an exemption that allows: “Tree removal necessary to comply with CDF (CALFIRE) Fire Safety Regulations (i.e., clearing around homes) or tree removal undertaken as a part of a fuel reduction/fire safety/fire protection program in conformance with commonly accepted CDF (CALFIRE) policies.”

Figure 1: Adopted Placer County Conservation Reserve Map (current as of July 2009)



Community Wildfire Protection Plan

There is a “Community Wildfire Protection Plan for the West Slope of the Sierra Nevada in Placer County” (CWPP; Holl 2008). The CWPP provides information on changes in historic recurrence intervals, potential fuels treatments, costs for treatments and other background. It proposes treatments for areas of the county with existing Fire Safe Councils e.g., Greater Auburn Area, Foresthill, etc.

At the present time (June 2009) the CWPP does not include the majority of the PCCP planning area. In May 2009, the County Board of Supervisors authorized the preparation of an annex to the CWPP that would cover much of the area. It also authorized the creation of a Fire Safe Council for rural Lincoln. The schedule for preparing the CWPP annex has not yet been established (Brett Storey, personal communication).

Placer County Fire Hazard Reduction and Biomass Utilization Strategy

The Placer County Wildfire Protection and Biomass Utilization Program (Placer County 2007) was developed to promote projects that will diminish the threat of catastrophic wildfires, improve public health and safety, reduce pollution, and enhance the environment. The main goals of the Program are to:

- Reduce the risk of catastrophic wildfires in Placer County.
- Protect Placer County citizens and visitors from the consequences of catastrophic wildfires.
- Find one or more beneficial uses for excess biomass in Placer County.
- Improve air quality in Placer County.

Establishment of one or more economically sustainable facilities that convert biomass into power, fuel, or another valued commodity appears to be the County’s best option for managing excess biomass and reducing the severity of wildfires. However, there are several constraints to establishing a biomass facility. These constraints include the ability to reliably procure and transport biomass feedstock; the ability to establish requisite infrastructure; the ability to obtain air quality permitting of the facility; and the ability to attract private investors (among other constraints).

The County has identified several key actions that will help it in meeting Program objectives. These include educating public citizens; developing strategic alliances with public and private partners; conducting coordinated and transparent planning; and obtaining funding. To accomplish wildfire safety objectives, the County will continue to implement established programs (e.g., Chipper Program) while implementing several new programs (e.g., Biomass Box Program, providing sites for biomass collection). To accomplish biomass utilization objectives, the County will coordinate or conduct technical studies designed to determine if it is feasible to establish a biomass facility in the County, and it will solicit interest and assistance from public and private stakeholders.

It is possible that implementation of wild fire management in PCCP conservation reserves could create opportunities for coordinating with the Program by providing biomass feedstock. This could be utilized in existing biomass power plants located in Lincoln and Rocklin or in a potential new facility located in western Placer County.

Proposed PCCP Policies

The PCCP is currently being prepared (as of June 2009). The following information is derived from the 2005 review draft PCCP and various background papers and reports.

Landscape Level Goals and Objectives advise the preparation of management plans for all conservation reserves. It is assumed that these plans would address wild fire management. The use of prescribed fire and targeted grazing for managing certain vernal pool grasslands is recommended within the draft goals and objectives.

Some “Best Management Practices” (BMPs) currently recommended for oak woodlands include:

- Maintain current oak canopy coverage (i.e., percentage of land occupied by oak canopy).
- Maintain a variety of size and age classes.
- Protect stump sprouts, retain snags, dead trees and downed wood.
- Incorporate fire into the management regime.

The County Aquatic Resource Program (CARP) is a component of the PCCP permitting process and is applicable to projects potentially affecting federal jurisdictional wetlands or streams subject to Sections 1600 et seq. of the State Fish and Game Code. When the PCCP is adopted, the CARP will require buffers to protect isolated wetlands, flowing springs and seeps. Within conservation reserves acquired under the PCCP, the requirements of the CARP will be implemented. The CARP will also apply to any land development or vegetation management activities requiring discretionary approvals from the PCCP implementing entity.

OTHER POLICIES AND REGULATIONS

Any fuels management project in PCCP conservation reserves will undergo review pursuant to the California Environmental Quality Act (CEQA) and/or National Environmental Policy Act. For projects funded under state and federal cost sharing programs, the lead agency responsible for conducting environmental review may be different than the PCCP implementing entity. As a covered activity under the PCCP, separate permits from the Army Corps of Engineers, Regional or State Water Quality Control Boards or Department of Fish and Game will not be required. Permits from the Air Quality Management District for projects involving burning will be required.

Projects in PCCP conservation reserves potentially affecting special status wildlife or plant species listed under state or federal Endangered Species Acts that are not covered under the PCCP may be subject to regulation by the Department of Fish and Game and/or US Fish and Wildlife Service.

WILD FIRE RISK

Definition

Risk is here defined as the probability that a wild fire will cause significant environmental and ecological damage to a conservation reserve and/or surrounding properties. The primary determinant of wild fire risk is the potential for ignition. Sources of ignition may be natural (lightning) or human use related. Susceptibility to lightning strikes varies in Placer County depending on elevation. Lightning is generally rare within the limits of the PCCP planning area. Human-caused ignition is more likely. In addition to arson, use-related sources of ignition may be legal or illegal recreational uses, vehicles, power lines and railroads.

Once a fire starts, a second determinant of risk is the likelihood that a fire will be sustained and spread. Putting aside for the moment the importance of environmental and fuel conditions, three scenarios are possible: 1) a fire may start within a reserve and be confined therein; 2) a fire may start within a reserve, burn there to some degree and spread to adjacent lands; and 3) a fire may start on adjacent lands and spread to the reserve. In any of these cases, there could be damage to the reserve from both wild fire and suppression activities.

A third determinant of risk is fire severity. As used in this document, fire severity means the degree to which existing vegetation is destroyed by a fire. An extremely severe fire is one in which essentially all vegetation is lost. Less severe fires may destroy under-story vegetation but leave most trees alive. Fire severity can also be expressed in terms of damage to soils and water quality. Extremely severe fires may change soil characteristics to the extent that regeneration and recovery are impaired. They may also cause short-term and long-term water quality impacts.

Other secondary determinants of fire risk include public attitudes and perceptions of risk and methods used to reduce risk e.g., fuels removal, prescribed fire, etc., regulatory constraints on risk management tools and costs for fuel management treatments. An additional unknown is the long-term effect of global climate change on weather and vegetation.

A manager can minimize wild fire risk to some degree by reducing the likelihood of ignition (restricting uses, patrolling, etc.) and improving access and suppression capabilities but the main way to minimize risk is to manipulate vegetation to reduce the chances that a fire will spread and cause severe damage

Factors Affecting the Extent and Severity of a Wild Fire

After a fire starts, there are several conditions that affect how it spreads and its severity. Fire weather has an overriding effect on fire behavior. Under certain weather conditions (low humidity, high temperature, high wind velocities) wild fire is essentially uncontrollable. These weather conditions are relatively infrequent but occur annually in Placer County.

Topography is a second condition that affects wild fire behavior. In general, steeper lands have a higher level of risk for two reasons. First, steep terrain affects local wind patterns and microclimate. Wind-driven wild fires tend to run up slopes, often at a fast pace. Second, the steepness of terrain affects actions to suppress wild fires. Suppression may be limited to breaks in slope at ridgelines when fast moving fires are racing up slopes. On very steep lands, suppression may be limited to aerial attack with air tankers and fire retardant. Prevailing weather at the time of the fire (temperature, relative humidity, winds) can exacerbate the effects of topography on fire behavior.

Access and suppression capability is a third condition that influences risk and damage when a fire starts. Particularly in the northern portion of the PCCP planning area, conservation reserves may be located at some distance from the nearest fire station. Aerial suppression capabilities may not be available. During times of dangerous fire weather and multiple starts, fire fighting priorities and resource allocations will focus on places where human resources, rather than natural resources are in danger.

The fourth condition affecting the extent of a fire and its severity is fuel loading and more specifically the interconnectedness between surface, under-story and over-story vegetation (ladder fuels). Continuity of fuels throughout a property and across property boundaries along with terrain, weather and other factors determine the potential for a fire spreading (Figure 2). The abundance of fuel at a given location largely determines its severity.

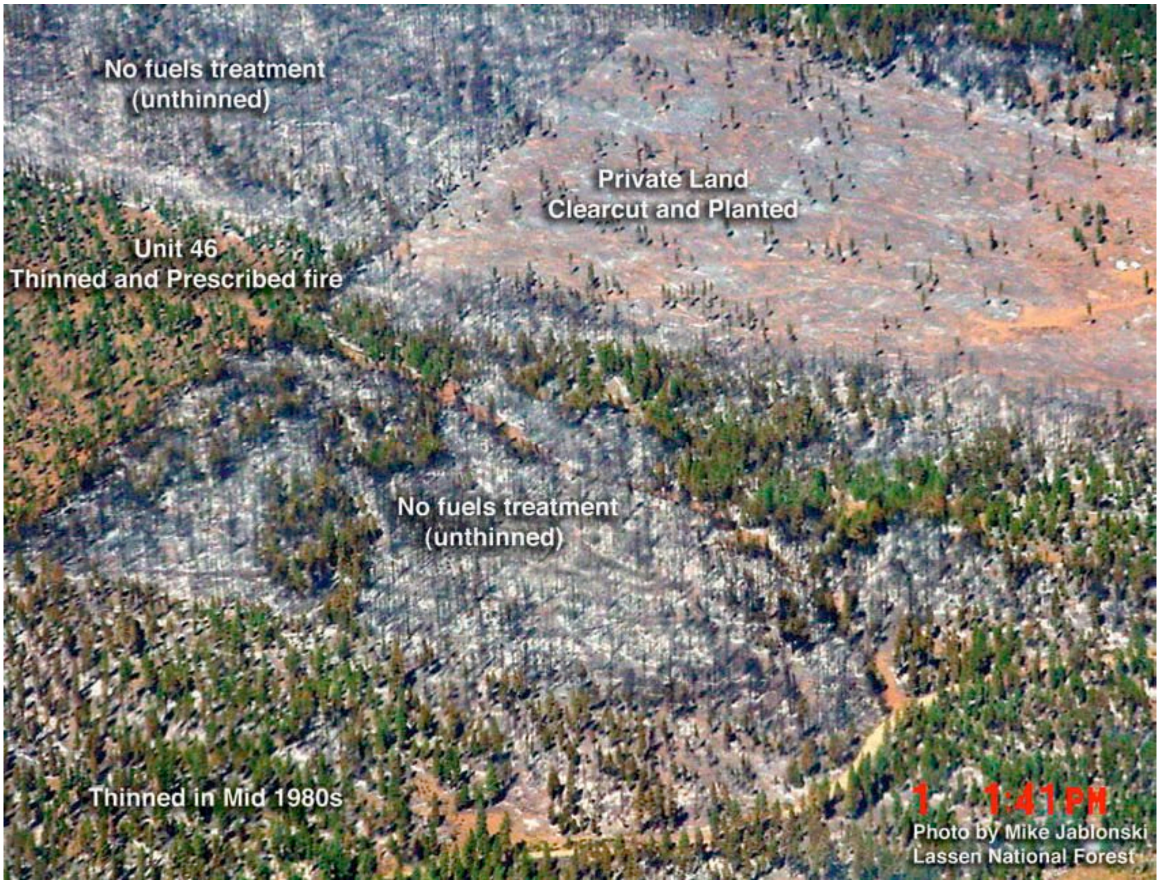


Figure 2: This photograph of the Cone Fire on the Black's Mountain Experimental Forest, Lassen National Forest graphically demonstrates the effects of reducing ladder fuels and fuels continuity. When wild fire reached areas that had been thinned and burned to reduce fuels, fire severity was reduced dramatically and the crown fire was suppressed. Nearly complete tree mortality was experienced in untreated areas. Although the Cone Fire was in coniferous forest, the expected performance of fuels treatments in other forest types would be similar,

Vegetation type influences fuel loads and the potential for development of ladder fuels. The PCCP targets the majority of habitat acquisitions to occur in vernal pool grasslands, oak woodland and riparian/stream system/wetlands (total up to 50,000 acres) by 2060. Of these, the oak woodland and some riparian woodland have the greatest potential for having high fuel loads (Figure 3).

Figure 3: This montane hardwood community illustrates the concept of ladder fuels. Substantial portions of Placer County's oak woodlands and some riparian woodlands exhibit high fuel loads due to a history of fire suppression policies, invasion of exotic species and management history.

Fuel loads at a specific location within a given vegetation type are affected by land uses, fire history, natural processes of mortality caused by insects and disease, and presence or absence of invasive species with high fire hazard (e.g., brooms and Himalayan blackberry). Climatic and weather cycles affect fuel loads, particularly in vegetation types where grasses and other herbaceous plants are a significant component. For example, when wet years occur and lead to high productivity of annual grasses, there can be significantly increased risk of wild fire in the summer and fall when the grasses are dried out. Conversely, consecutive years of drought can increase the susceptibility of trees and shrubs to disease and insect attacks that cause mortality and thereby increase fuel loads.

Of the vegetation types proposed for conservation in the PCCP, oak woodlands have the highest inherent fire risk because they tend to have higher fuel loads relative to the other vegetation types, they are commonly located in steeper terrain and are least accessible. Riparian woodlands may have high fuel loads but mesic conditions may reduce inherent fire risk. Vernal pool grasslands are generally subject to a lower level of wild fire risk in the sense that they usually only have surface fuels and fires are generally not going to cause permanent damage. It should be acknowledged, however, that any vegetation type can have a wild fire risk varying from low to high depending on site-specific fuel loads and other factors.

REDUCING RISKS THROUGH FUELS MANAGEMENT

Fuels are managed to obtain desired changes in fire behavior and approaches to management vary by fuel type (Table 1). Treating fuels may reduce rates of fire spread and may reduce the severity of a fire. Treating fuels cannot prevent a fire from occurring. Reinhardt et al. (2008) discuss many aspects of fuels treatments and concluded that "treatment in wild lands should focus on creating conditions in which a fire can occur without devastating consequences rather than creating conditions conducive to fire suppression." For some conservation reserves this may be a useful operating principle. In other cases, however, where reserves are situated near neighborhoods or other infrastructure, enhancing suppression capability or reducing the rate of spread may be key goals for fuels treatments.

Table 1: Fuels management objectives and prescriptions (after Finney 2004).

Fuel Target	**Prescription(s)**	**Change in Fire Behavior**
Surface fuels (live grass and brush, and dead and downed woody material)	Mechanical treatments and prescribed burning to remove, compact or reduce continuity of surface fuels	Reduce spread rate and intensity, limit ignition of tree crowns* and other aerial fuels
Ladder fuels (small trees, brush, low limbs)	Thinning (small-diameter trees) and prescribed burning (scorching and killing small trees and brush) to decrease vertical continuity between surface and crown fuels	Limit ability for fire to transition from surface to crown fire by separating surface fuels from crown fuels
Canopy fuels (fine fuels like dried leaves and small twigs in tree crowns)	Thinning to reduce horizontal continuity of crowns (e.g., overstory thin)	Limit spread of crown fire

*The crown of a tree is the entirety of its foliage. A crown fire refers to one which occurs within the canopy and is carried from tree to tree by ignited crowns.

Environmental Constraints on Fuels Treatments

Consider the PCCP communities that will be acquired. In vernal pool grasslands, fine surface fuels are predominant (Figure 4). Management may entail using prescribed fire, grazing or mowing to keep fuel loads under control. Environmental impacts will be limited with most concern centered on biological and hydrologic effects of treatments, including effects on PCCP covered species and other wildlife.

Figure 4: Vernal pool grasslands generally only have surface fuels.
Hardpan soils limit establishment and growth of shrub and tree cover.

Treatments intended to reduce fuel loads in forest and woodland settings are more complex. Surface, ladder and canopy fuels are often all present. Highest priority is usually placed on reducing ladder and surface fuels because they connect the tree canopy with the ground.

Methods for fuels management fall into four general categories: 1) mechanical (mechanized) harvesting; 2) hand harvesting; 3) prescribed fire; and 4) grazing and browsing mainly to reduce surface fuels. Depending on the method used, potential environmental impacts may occur due to site disturbance and changes in the plant community. In the context of managing conservation reserves, considering these impacts and mitigating them is of equal or greater priority to reducing fire risk. The main reason for acquiring conservation reserves is to secure permanent protection for important ecosystems. These ecosystems will provide habitat for covered animal and plant species and other organisms. Therefore, a principal constraint on fuels management is maintaining the habitat and ensuring that there are no significant impacts on covered species.

Additional environmental constraints include:

- Fuels treatments will be constrained by topography and geologic hazards on acquired parcels. These constraints are most important in upland oak woodland habitats. Topography and geologic hazards will limit the use of mechanized harvesting for fuels reduction.

- Water courses and wetlands found on conservation reserves require special attention so that water quality and other impacts can be avoided during fuels treatments.

Protection is normally provided with stream and wetland buffers wherein vegetation removal and ground disturbance are prohibited or limited.

- It is likely that some acquired parcels will have significant historical and archeological resources that should be protected during fuels treatment activities. These may not be known to exist before discovery during project implementation.

- In regard to the use of prescribed fire, smoke and air pollution are critical issues for both residents and for determining attainment of air quality standards.

- Existing and planned land uses in the vicinity of conservation reserves will affect the feasibility of managing fuels, in particular, the use of prescribed fire.

Potential Impacts of Treatments

As a rule, mechanized treatments involving heavy equipment have the potential for creating the greatest level of site disturbance and potential impact (PSW 2008). There are machines that have been developed to minimize site disturbances such as soil compaction (Poff 2006; Rheinberger 2008). When mechanized operations are conducted with these types of machine and further restricted from environmentally sensitive areas such as steep slopes and riparian zones, environmental impacts can be imperceptible.

Hand harvesting is labor intensive, potentially dangerous and can be slow work. Conservation and inmate crews are commonly used to do fuels management manually. Hand harvesting may be the only acceptable approach in sensitive areas.

Prescribed fire, including broadcast burning or “jackpot” pile-and-burn is an attractive alternative for fuels management. Pile and burn practices are typically used to dispose of slash generated from thinning operations. Caution must be exercised when burning piles to mitigate potential impacts on soil beneath the piles. Broadcast burning may also be used to remove residues and reduce surface fuel loads.

Prescribed fire can be designed to mimic natural processes and over the long-term, it would be desirable to use prescribed fire in appropriate locations as a tool to manage fuel loads in conservation reserves. For several reasons, this may not be entirely feasible. First, under today’s air quality control regulations, use of prescribed fire is substantially restricted due to impacts from smoke and particulate matter. Second, some, if not many conservation reserves may be too near to urban and rural residential areas to be effectively managed with fire. Third, prescribed fire has the potential to adversely affect resident and migratory wildlife if conducted at the wrong time of the year (especially in the spring). Finally, the liability associated with an escaped fire may deter risk-averse managers from using it. A viable alternative to burning in either oak woodland with grass under-story or vernal pool grasslands is the use of grazing and browsing animals (Figure 5).

Figure 5: Surface fuel loads in this conservation reserve located near Loomis are effectively managed with grazing animals (sheep and goats).

In considering the environmental impacts of a specific practice in a specific place, there are several relevant questions:

- Are there sensitive areas such as steep slopes or riparian zones located within the proposed treatment area?

- Are any special status wildlife or plant species present? Have surveys been conducted to determine their presence or absence? Note that species covered under the PCCP need not be surveyed.

- What will be the prescription? Will over-story trees be removed? Will under-story trees, shrubs and/or herbaceous vegetation be removed? What is the desired future condition of the vegetation and how will the prescription serve to achieve that condition (considering both wild fire risk and habitat requirements of covered species and other wildlife and plant species)?

- How will residues be treated? Will they be removed from the site, lopped and scattered, chipped and distributed across the site or piled and burned? Will mastication be employed (Figure 6)?

- What time of the year will the treatments be done? Impacts to wildlife and special status plants can be significant if treatments are improperly timed relative to their habitat requirements, breeding behavior and phenology.

- What mitigation measures will be required to offset potential impacts?

Figure 6: Mastication is the use of a grinding head to literally “chew” up brush and small trees. It is particularly effective in very dense young stands of trees or in brush fields. At Sacramento National Wildlife Refuge Complex, mastication is used to remove patches of Himalayan blackberry (Joe Silveira, personal communication)..

Two particular concerns for operations within conservation reserves are protection of habitat for sensitive species (covered by the PCCP or not) and maintenance of biological diversity. Restricting removal of large trees and snags, limiting times and types of operations and avoiding habitats may all be required to ensure against taking these species. Protecting biological diversity may require additional measures. For example the treatment of residues can have impacts on regeneration of under-story plants. A layer of masticated residues can impair germination and burn piles can lead to sterilized soils (PSW 2008). In situations where restoration of native herbaceous communities is a desired outcome, treatments of residues may need adjustment. Another potential conflict arises when surface fuels treatments such as prescribed fire or mowing occur when ground-nesting birds are present (Anonymous 2008).

Projects with the least likelihood of causing significant impacts will:

- Avoid sensitive areas and/or limit operations in sensitive areas to minimize impacts (including cultural sites, wetlands, steep slopes, etc.).
- Minimize impacts on covered species and other wildlife and special status wildlife and plant species not covered by the PCCP.
- If in woodlands, focus on removing ladder fuels while retaining larger trees.

- Retain some under-story and leave as much residual material on-site as possible (while minimizing surface fuel loads).

Generic prescriptions can only suffice to cover broad issues and avoid relatively obvious problems. In all cases, site-specific assessments and prescriptions for fuels treatments will be required. These may include field surveys to determine presence or absence of special status wildlife or plant species not covered by the PCCP. Fuels treatment projects in conservation reserves managed by the PCCP implementing entity will be a covered activity under the PCCP. As such, they will be subject to programmatic mitigation. They will also be subject to CEQA. The lead agency responsible for environmental analysis may differ from the PCCP implementing entity in cases where funding is obtained from other sources e.g., CALFIRE or Sierra Nevada Conservancy. In cases where federal funding is involved, they could be subject to NEPA. An environmental review process for fuels treatments should be incorporated into the framework for PCCP implementation. Consideration might be given to developing a programmatic environmental document covering the fuels management program comparable to a “Program Timber Environmental Impact Report” under the State Forest Practice Rules (Baldwin, Blomstrom, Wilkinson and Associates 2004).

WILD FIRE MANAGEMENT GOALS

The primary goal for wild fire management in conservation reserves is to minimize the potential direct and indirect (suppression-related) impacts of wild fire. This is to be achieved by reducing the probabilities that a fire will spread from a reserve to adjacent lands or vice versa and reducing the potential severity of fire within a reserve. Additional goals are:

- Minimize the environmental impacts of fuels management treatments and wild fire suppression.

- Minimize costs and requirements for maintenance.

- Use fire management as a tool to maintain and enhance the ecological characteristics of reserves.

FUELS TREATMENT ZONES

Reduction of fuels has three main purposes: 1) reduce fire severity within reserves; 2) reduce the ability for a fire to spread from a reserve to adjacent lands; and 3) reduce the ability for a fire to spread from adjacent lands to a reserve. An added benefit of fuels reduction is to create places where fire-fighting forces can stage and conduct suppression actions. It should be noted, however, that under extreme weather conditions, any fuels treatment could be ineffective. Therefore, fuels treatments are generally aimed at reducing fire severity and spread under mild to moderate fire weather conditions.

In forest and woodland vegetation types, reducing fire severity is achieved by limiting the potential for a fire to escalate from the ground where it typically starts to shrub and tree vegetation layers. A “crown fire” occurs when a fire reaches the tree layer and then spreads from tree to tree. When this occurs, burning crowns produce brands or embers that can travel large distances, especially under strong wind conditions, and cause spot fires. Separating vegetation layers vertically and horizontally can help to confine fires to the ground. It is necessary to also reduce surface fuels because build-ups of surface fuels lead to increased flame lengths that can then even reach separated vegetation layers (Figure 7).

Figure 7: This photograph illustrates the effects of surface fuel loads on flame length. The grass fuel in the foreground is burning at a few inches above the ground. The accumulation of woody material in the center of the picture has a flame length of several feet. Even if ladder fuels have been treated, fuel lengths of this magnitude have the capacity to reach shrub and tree canopies.

The issue of reducing fire severity in vernal pool grasslands is not as critical as it is in woodland communities because shrub and tree vegetation is nearly always limited or is absent altogether. Vernal pool grasslands can be managed to reduce surface fuels over relatively large areas with tools such as prescribed fire and targeted grazing.

In oak woodlands and riparian areas it is not feasible to uniformly reduce fuel loads over extensive areas due to costs. Also, since conducting fuels treatment usually entails simplifying vegetation structure (i.e., reducing canopy height diversity) there are potential impacts on wildlife that may be unacceptable in a conservation reserve. One approach is the use of treatments strategically placed in key locations to prevent spread of fire (Finney 2001; Joint Fire Science Program 2009). The goal of this approach is to produce the greatest reduction in overall fire-spread rate with a minimum of treated area. Fire behavior modeling indicates that if 20-30 percent of an area is treated, there will be positive results beyond the area of treatment alone. There is no empirical evidence to support this approach but several field experiments are in the planning stages (as of June 2009).

A second approach that is being used for spatially extensive treatments in other conservation areas in the Pacific Northwest is called “variable density” or “mosaic thinning” (Stringer 2004; Martinez 2008). In this approach, tree and shrub groups are vertically and horizontally separated to reduce potential crown fires and threat of spread. To minimize habitat impacts, some groups may be left untreated and relatively dense. One objective of this approach is to maintain all species, all age and size classes of trees, and shrub cover for wildlife habitat.

Fuels treatments in woodlands that provide vertical and horizontal separation between trees, shrubs and ground cover can effectively prevent tree and shrub mortality due to fire. The results after a fire may be very similar to what would have occurred under historic fire regimes (Figures 8 and 9).

Figure 8: This picture illustrates a situation in which a ground fire burned through oak woodland without spreading to the tree canopy, resembling potential fire behavior under pre-European settlement conditions.

Figure 9: Some oak woodland in Placer County is naturally resistant to severe damage during fires because trees are separated from each other, ladder fuels are absent and surface fuels are maintained at low levels due to grazing. For the relatively dense riparian corridor traversing the lower part of this picture some selective thinning could reduce fuel loads.

While treatments within the interior of a reserve can reduce fire severity, reducing the potential for a fire to spread to or from a reserve may require treatments along roads used by the public and along property boundaries. Generally, these are treated by reducing ladder fuels and thinning to create a “shaded fuel break” in forested areas. In grasslands and shrub fields, fuel breaks along roads and property boundaries can be created by mowing, disking, prescribed fire or grazing.

Shaded fuel breaks range in size from 50 feet on either side of a road to a quarter mile in cases where fire-prone areas are adjacent to neighborhoods or other sensitive areas. They may not stop a fire but they are intended to make a fire drop from the canopy to the ground. Therefore, treatment of ground fuels is essential. Shaded fuel breaks serve to provide staging areas for fire suppression forces (Figure 10; CALFIRE 2005; Ferrier et al. 2007). They are especially important along roads where ignitions commonly occur and a rapid response can minimize the spread of a fire.

Figure 10: Shaded fuel break at Hidden Falls Regional Park in oak woodland. The combination of the treated area and road will impair the spread of a fire, provide access to fire fighters and provide a staging area to fight the fire.

There is considerable information that demonstrates the effectiveness of shaded fuel breaks in reducing fire spread and enhancing suppression activities. For example, shaded fuel breaks in the 2007 Angora fire area performed well in protecting some neighborhoods (Murphy et al. 2007).

A comprehensive fire management plan for a conservation reserve will include mapping of treatment areas as described above and prescriptions for each area that balance ecological and environmental constraints with fire protection. In the next section, general prescriptions for fuels treatments in PCCP vegetation types are described. These are followed by best management practices recommended for environmental protection.

FUELS MANAGEMENT OBJECTIVES AND PRESCRIPTIONS

The overarching desired outcome of the PCCP fuels management program is to reduce the risk of habitat destruction caused by moderate to high severity wild fires. Risk reducing treatments must be undertaken without sacrificing the ecological values of conservation reserves or having significant impacts on PCCP covered species.

A second desired outcome for fuels management is to create conditions under which historic fire regimes or surrogates may be re-introduced to PCCP communities. For some communities, that entails reversing the ecological changes that have occurred over the past 100 years due to past land uses and fire suppression i.e., implementing pre-treatment to reduce excessive fuels before re-introducing fire. Re-introduction of fire is not considered feasible for all locations. Consequently, surrogates for fire both mechanical e.g., mowing, thinning, etc. or biological e.g., use of grazing or browsing animals may be used.

It is important to acknowledge the potential area of conservation reserves to put prescriptions and feasibility of implementation into perspective. Table 2 indicates the amount of land within the PCCP planning area currently in reserve status under Placer County and other management. It also indicates the area by vegetation type that is within the designated Conservation Opportunity Area where conservation reserves will be acquired. It should be noted, that not all of this land may ultimately be acquired. Also, some lands may be acquired in fee title while other lands will be protected with easements or other tools, including regulation. The amount of acquisition will be determined by the level of habitat losses to development, availability of funding and other factors such as the willingness of sellers. Not shown in Table 2 is the area that is potentially developable outside the Conservation Opportunity Area where at least some conservation reserves will be acquired.

Table 2: Existing Conservation Reserves, by PCCP Vegetation Type and Area Designated for Future Acquisitions (rounded numbers; accurate as of June 2009)

Vegetation Type	**Existing Reserves (acres)**	**Reserve Acquisition Area (acres)**
Vernal pool/grassland	8000	22,000
Oak woodland	2000	11,000
Riparian*	400	3000

*Note that riparian only includes riparian woodland cover and does not include associated vegetation types or floodplain that is currently in reserves or potentially in new reserves.

There are no available data that would document how much of existing reserved area is currently under management to reduce fire risk. The County's Hidden Falls Regional Park (1100 acres of oak woodland) is actively managed to reduce risk, primarily with shaded fuel breaks (Ferrier et al. 2007).

The implication of this information is that the PCCP implementing entity will be faced with managing a relatively large amount of land in order to reduce fire risk. It is presumed that priorities for treatments will be programmatically based on inherent wild fire risk, proximity to human settlement, reserve uses and available funding.

Prescriptions by Treatment Zone and Vegetation Type

Table 3 indicates what treatment zones, as previously described are found in the PCCP vegetation types. Oak woodland conservation reserves have all treatment zones. They may be bounded by or traversed by public roads, they have boundaries with other mainly private properties, they may require internal fuel breaks and they may have fuels treatments applied to entire parcels and at the landscape scale.

Table 3: Treatment Zones within PCCP Vegetation Types

Vegetation Type	Treatment Zone			
	Road corridors	**Property boundaries**	**Fuel breaks (internal)**	**General (parcel)**
Oak woodland	X	X	X	X
Vernal pool/grassland	X	X	N/A	X
Riparian woodland	N/A	X	X	X*

*Riparian woodlands may be found in association with other vegetation types and may be treated as part of a fuels management plan for the entire parcel.

Vernal pool grasslands may also have adjacent or intersecting roads and be adjacent to private properties. They are unlikely to require internal fuel breaks but they may require fuels treatments on a parcel scale.

Riparian woodlands will be components of conservation reserves mainly comprised of other vegetation types or they may be separate conservation reserves (Figure 11). In either event, most will only have road crossings at defined locations. When created as separate parcels as for example in a conservation easement, they may have boundaries in common with private lands. As discussed below, fuel treatments within and adjacent to riparian woodlands may be an important step in reducing risk. Riparian woodlands may receive treatment as part of a larger conservation reserve.

Figure 11: This picture illustrates a situation in which two conservation reserves are bounded by roads and private properties (oak woodland left center and riparian woodland at bottom). Fuels management would occur along roads and at property boundaries to prevent wild fire spreading either onto the reserves or from the reserves onto adjacent properties. Within the reserves, ladder fuels may be reduced to prevent crown fires.

Oak Woodlands: Road Corridors, Property Boundaries and Fuel Breaks

The prescription for these three treatment zones will be the same: shaded fuel break. In a shaded fuel break larger trees are retained and under-story ladder fuels are removed. Surface fuel treatment may include lopping and scattering slash, broadcast burning, pile and burn, grazing and/or spreading of chips or masticated materials. Shaded fuel breaks function by causing crown fires to drop to the ground when fire enters them. They are most effective when they are at least 100 feet wide.

The shaded fuel break prescription proposed for conservation reserves requires retention of larger trees (>10 inches diameter breast height (dbh)), pruning of larger trees to a height of 8-10 feet above the ground and separation of residual trees by a distance ranging from 20 feet between trunks or up to 15 feet between drip lines (CALFIRE 2005). Small dead and down material (5-8 inches diameter, up to 5 feet long) is removed or treated in place. Trees with obvious wildlife use and snags >18 inches that are not adjacent to a road or structure should be retained. Some under-story shrub cover may be retained, particularly species that provide wildlife food or cover. Shrub cover should be left in patches that are separated from trees (not within their drip lines). To minimize fire risk patches should be <5 feet tall and <5 feet wide. Larger patches are superior habitat for wildlife and in certain instances may be retained.

A successful shaded fuel break will not only reduce fire severity but it will also promote development of larger trees by reducing competition on the treated site. This will move the treated area towards a future condition resembling pre-settlement oak woodland: relatively open stand with larger trees and open under-story. Re-introduction of fire or grazing to maintain the open under-story will be an essential maintenance practice.

Oak Woodlands: Parcel and Landscape Scales

The objective for oak woodlands at the parcel and landscape scales is to reduce wild fire risk while simultaneously moving the woodland into a more resilient ecological state. Where feasible this will include re-introducing fire as a critical ecological process.

Oak woodlands in Placer County are diverse in structure and composition and consequently, every parcel where large-scale treatment is proposed must have its own site-specific prescription. There are some guiding principles that can be used to design prescriptions however, and these relate to both stand structure and strategic positioning of treatment areas.

Many oak woodlands are currently in an even-aged state that resulted from historical events such as clearing and/or wild fire. The desired future conditions in many cases will be a mosaic of tree age classes that is spatially patterned to mimic both individual tree and group mortality. Large residual trees should be retained as the “ecological anchors” of future stands (Martinez 2008). Emphasis should be placed on thinning from below to reduce ladder fuels and to enhance the vitality and growth of residual trees. Some smaller trees should be left so that all pre-treatment age and size classes are represented (Figure 12).

Figure 12: This picture illustrates the results of a treatment in which under-story trees are removed and larger trees are left. In the background of the picture, an untreated denser patch is left to reduce habitat impacts. The resultant stand consists of a mosaic of open and denser areas in which the treatments are strategically placed to reduce fire severity. Follow-up treatments would entail use of prescribed fire or grazing animals to control surface fuel loads.

To maintain habitat values, some proportion of defined treatment areas should be left un-thinned but pruned to reduce connectivity to surface fuels. Shrub patches should be retained as well but separated horizontally and vertically from residual trees.

Slash derived from thinning may be piled for later burning, chipped and spread or lopped and scattered. Larger materials may be piled for use by wildlife. In the latter instance, slash piles should be separated from residual trees and shrubs and surrounded by 5-foot wide fuel breaks. In certain instances, there may be opportunities for materials to be transported off-site for use as biomass power feedstock or firewood.

Deciding where within a parcel or a landscape a treatment should be applied to maximize fire risk reduction is an evolving science. The USDA Forest Service is attempting to implement a system of strategically located fuels treatments at some sites within Sierra Nevada National Forests. The approach is based on research conducted by Finney (2001; 2004) and is known by the acronym “SPLATS” which stands for Strategically Placed Landscape Area Treatments. Modeling results indicate that SPLATS arranged in overlapping patterns perpendicular to predicted direction of fire spread have significant effects on fire severity and spread when 20-30 percent of the “fire shed” is treated. No empirical evidence exists to support this approach but as experimental results are obtained, the PCCP implementing entity should consider whether it is appropriate for oak woodland conservation reserves.

Riparian Woodlands

Riparian woodlands consist of linear corridors. Fuels treatments may be required at their edges where they interface with other vegetation types within conservation reserves or within private properties. For larger riparian reserves, they may require treatments in their interior. Riparian areas rarely support high severity wild fires unless they have been degraded (Figures 13 and 14; Beche et al. 2005). For example, in cases where exotic plants have invaded riparian areas and increased fuel loads they may be susceptible to devastating fire effects. This was the case in the 2008 Gladding Fire at the Doty Ravine Conservation Reserve. A fire that started in grassland was spread down Doty Ravine and off-site by dense Himalayan blackberry. Fire risk in riparian areas can also be increased when de-watered floodplains have been invaded by upland species that have less resistance to fire (lower fuel moisture) than riparian species.

In general, fire hazard is greater along intermittent and ephemeral streams than perennial streams that tend to have more mesic microclimates, higher levels of soil moisture and higher levels of moisture in plants.

Figure 13: As indicated in this photograph, riparian vegetation along streams may survive wild fire in at least some cases because of fire behavior (fire tends to run up slopes rather than down slopes) and relatively mesic microclimate.

Figure 14: Fire occurred within this riparian woodland in 2001 eight years prior to the photograph. Mortality was spotty but several large trees were killed. Shrubs and deciduous trees have recovered. This pattern is typical for fires in riparian zones.

The actual width of a riparian woodland corridor will vary depending on stream type, geomorphology and location in a watershed. Studies of streams in western Placer County indicated that riparian corridors range from less than 50 feet up to several hundred feet on either side of a stream (Jones and Stokes 2004).

Current guidelines applied by CALFIRE to fuels treatments in the Yuba-Nevada-Placer Counties require riparian buffers established by the Forest Practice Regulations (CALFIRE 2005). Considering excessive fuel loads in some riparian areas, CALFIRE is now (June 2009) evaluating changes to operations that would permit more aggressive fuels treatments within buffers (Matthew Reischman, personal communication).

Rather than specify buffers based on stream class, treatment prescriptions presented here are based on the concept of different ecological zones. That is, they acknowledge that different locations within a riparian corridor perform different ecological functions, as described below. This concept is currently (June 2009) being used by the State Board of Forestry to develop new regulations for timber operations in watersheds known to support threatened or endangered fish species or listed as impaired under Section 303-d of the Clean Water Act (California State Board of Forestry 2009). The Board's regulatory approach is based on an extensive review of riparian functions conducted by a consultant group and input from a Technical Advisory Committee (Liquori et al. 2008).

The following prescriptions apply to perennial, intermittent and ephemeral streams supporting obligate[2] riparian vegetation.

1. The bed and banks of the stream (bankful limits) and the vegetation closest to the channel is referred to as the “core zone”. This zone may extend up to 30 feet landward from the stream bank or to the outer edge of riparian vegetation whichever is less. Vegetation located in the core zone functions to maintain bank stability, provide shade to cool water temperatures and enhance instream productivity and habitats by providing litter and wood inputs.

   With limited exceptions, no vegetation removal or equipment operations should occur in the core zone. As a rule, no new stream crossings, roads or trails should be constructed only to facilitate fuels treatment. If thinning or vegetation management occurs in the vicinity of the stream, the debris should not be allowed to enter or cross the stream.

   It is acknowledged that there will be instances in which vegetation treatments in the core zone are desirable. Fuels treatments may be permitted provided that no disturbance occurs within the bankful limits of the stream. This would be the case where the core zone is dominated by exotic species such as Himalayan blackberry.

   Other exceptions may be allowed to either re-locate or upgrade deficient stream crossings.

2. For streams with larger floodplains and riparian corridors the “inner zone” extends landward from the core zone for up to 70 feet or to the edge of the riparian vegetation whichever is less (total up to 100 feet). This zone may have the highest diversity of species and vertical vegetation structure diversity. It functions as wildlife habitat and as a source of woody debris and litter to the stream. Taller trees may also provide shade canopy to moderate water temperatures.

   Use of ground-based equipment should be avoided within the inner zone. Hand treatments to reduce ladder fuels would be preferable with emphasis on removing exotic plants or upland species that have invaded the riparian zone.

   Over-story trees or any tree greater than 10 inches dbh should not be removed except in limited cases to eliminate overlapping crowns, eliminate exotics or to remove trees that pose a hazard. Larger trees may be pruned to a height of 8-10

[2] Obligate riparian vegetation is plants that require the moisture levels, soils and microclimate found along water courses. Examples include sedges and rushes, willows, alders and cottonwood. Oaks would be considered facultative riparian species in that they can thrive both along streams as well as in upland areas.

feet above the ground if live crown ratio can be maintained at 50 percent. Post-treatment canopy cover should be maintained close to pre-treatment levels.

Under-story vegetation may be thinned to reduce both vertical and horizontal continuity of fuels while maintaining wildlife habitat values. Individual plants or groups of plants up to 10 feet in canopy diameter may be retained if separated by 3-5 times the height of residual plants and not within the drip-line of residual trees.

3. Within the majority of the PCCP planning area, most riparian zones will be 100 feet wide or less on either side of the stream. On larger streams mainly at lower elevations, the riparian zone may exceed 100 feet. On those streams, the area beyond 100 feet is termed the “outer zone”. The primary objective within the outer zone is to interrupt the spread of fire from the upland to the riparian zone or vice versa.

   Within riparian areas at distances >100 feet, a shaded fuel break prescription (as previously described for oak woodlands) may be applied provided that the use of ground based equipment should be limited and work will generally be done by hand. If the use of ground based equipment is proposed, adequate mitigation measures should be implemented to prevent environmental impacts.

Figures 15 and 16 provide illustrations of the different management zones along streams in the PCCP planning area.

Figure 15: The core zone is delineated with the blue lines and includes the channel and adjacent vegetation up to 30 feet from the channel. In this picture, there are no locations where the riparian vegetation extends for more than 100 feet. This is typical for many of the streams in the foothills.

Figure 16: In this location, the floodplain is wide and there is a core zone (within blue lines), inner zone (between blue and yellow lines) and outer zone (between yellow and red lines). Vegetation removal would be avoided in the core zone, ladder fuels could be treated in the inner zone and a shaded fuel break could be implemented in the outer zone. Note that the riparian zone on the south side of the stream is narrower and only has a core zone and inner zone. Fuels treatments there would focus on the interface between upland and riparian vegetation.

On streams with especially large floodplains special conditions may exist. These streams may have multiple channels and riparian corridors (Figure 17). In such cases, the riparian zone boundary corresponds to the boundary between the geomorphic floodplain or channel migration zone and the upland. There may be more than one core zone and/or inner zone. Each of these should be considered independently for purposes of fuels treatments.

Figure 17: This picture illustrates a braided channel reach within Hidden Falls Park on Coon Creek. The channel in the foreground meanders through the floodplain. The main channel is located in the background. In considering fuels treatments for this location, each channel should be designated with its own core zone. The inner zone lies between the two channels. The riparian zone boundary would be at the boundary between the geomorphic floodplain and the uplands. This situation can exist even if at certain times of the year only one channel is flowing.

In summary, in any riparian area, disturbance to the channel and vegetation immediately adjacent to it should be avoided. Use of ground-based equipment should be minimized unless adequate environmental protection can be demonstrated (Poff 2006). Ladder fuels may be treated within the interior of the riparian woodland. Emphasis should be placed on fuels reduction at the immediate interface between the riparian and upland vegetation to interrupt the spread of fires (Figure 18). In many cases this interface will consist of grasses that can be controlled with grazing.

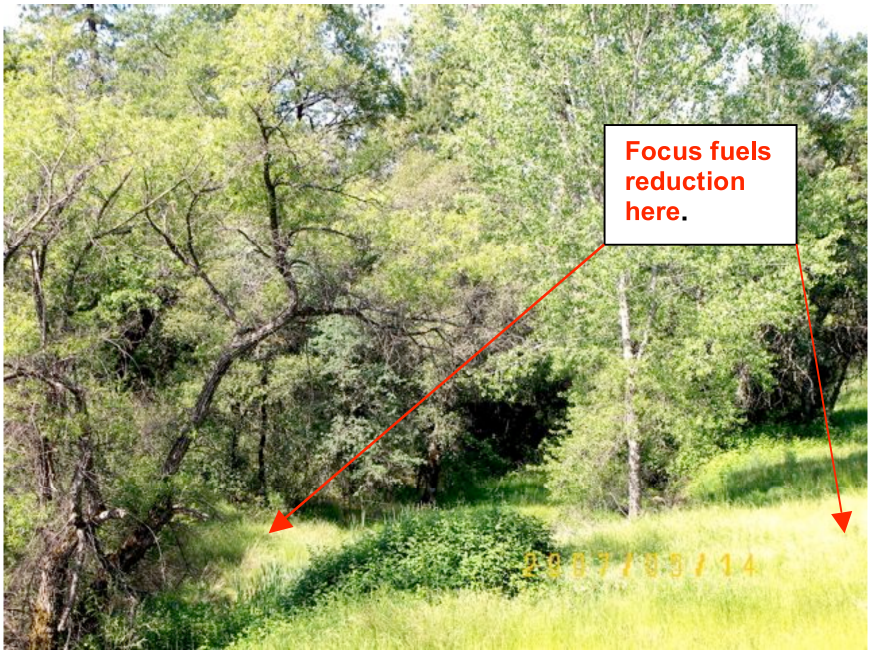


Figure 18: This picture illustrates a common condition along Placer County streams. The core zone is immediately along the stream (not shown). The inner zone is the relatively dense vegetation dominating the photograph. Fuels management objectives would be to reduce ladder fuels within the inner zone while retaining its ecological functions. More aggressive fuels management would occur at the interface with upland vegetation to reduce potential spread of fire from the riparian zone to the uplands or vice versa.

It should be noted that the County Aquatic Resource Program (CARP) would require implementation of buffers along streams that vary in size depending on stream class. Conformance with CARP requirements is a basis for blanket permitting under Sections 404 and 401 of the Clean Water Act and Sections 1600 et seq. of the California Fish and Game Code. The prescriptions recommended here for fuels treatments in riparian zones would permit limited vegetation management to reduce wild fire risk within CARP buffers.

Vernal Pool Grasslands: Road Corridors and Property Boundaries

The PCCP will advocate the protection of relatively large vernal pool complexes within conservation reserves. Less emphasis will be placed on protection of individual vernal pools. There will be circumstances in which vernal pool grassland conservation reserves are contiguous to roads, developed properties or agricultural properties (Figure 19).

Figure 19: This vernal pool conservation reserve is bordered by a road and urban development. The interface between the complex and the road should be managed to reduce fuel loads and interrupt the spread of fire.

Fuels at the interface between roads, other properties and vernal pool grassland complexes can be effectively reduced through grazing, disking and/or mowing outside of the vernal pool environment (Joe Silveira, personal communication). Fuel breaks between vernal pool grassland conservation reserves and other properties perform a dual function. They can prevent fire from spreading property to property. They can also help reduce impacts of suppression if a fire occurs by negating the need to construct fire lines. If weather conditions and fuel loads allow, a fire contained within vernal pool grassland may be permitted to burn with little likelihood of permanent environmental damage if it occurs at the appropriate time of year. Use of herbicides should be avoided in vernal pool grassland and no equipment operation should be permitted within the topographic depression(s) defining the vernal pool ecosystem.

Vernal Pool Grasslands: Parcel and Landscape

Options for fuels reduction within vernal pool grasslands include the use of prescribed fire, grazing or mowing. Disking is not permissible. Any approach to management must be ecologically sound and have a primary goal of protecting and/or enhancing the resource. As previously noted, the fire hazard associated with vernal pool grasslands is limited relative to woodland conservation reserves.

Mowing is not considered a feasible option for managing fuels at the parcel or landscape scales. Prescribed fire is sometimes used to reduce the cover of exotic grasses and pest plants in vernal pool grasslands. These effects vary by site, are not long-lasting and may not result in an increase in native species cover (Jaymee Marty and Joe Silveira, personal communications). Prescribed fire does not appear to have beneficial hydrologic impacts on vernal pools (Jaymee Marty, personal communication). If applied, prescribed fire must be implemented at the right time of year to avoid impacts on special status plant and wildlife species.

Experiments with managed grazing in vernal pool grasslands have indicated its ability to maintain native plant and aquatic organism diversity, to have beneficial hydrologic impacts and to minimize invasions by exotic species (Marty 2004; Marty 2005; Marty 2007; Pyke and Marty 2005). An additional benefit is reduced fuel loads.

Discussions with vernal pool managers provide insights into the advantages of using grazing as a tool to both reduce fuels and maintain the pool systems. Three key considerations are: 1) preserving levels of soil compaction that maintain the hydrologic properties of the pool (depth, area and duration of inundation); 2) preventing development of a "thatch" layer of dead vegetation that impairs regeneration of desired plant species; and 3) preventing potential invasion of pools by grasses or other undesirable plants. Using cattle to graze pools and adjacent grasslands has been proven to achieve all three objectives (Jaymee Marty and Joe Silveira, personal communications). Cattle hooves compact soils and keep them from "fluffing up" and becoming more permeable. Cattle will also break up thatch and incorporate the organic matter into the soil or consume it. Finally, unlike sheep that will not enter wet areas, cattle will enter the pools and due to their food preferences, selectively graze grasses while leaving the desired forbs alone.

Prescriptions for grazing in vernal pool grasslands should be based on site-specific conditions. As a general rule, summertime grazing should be avoided. Early spring grazing is important for reducing thatch (Jaymee Marty, personal communication). Grazing from October to June is optimal, the grazed area should be as large as possible and cattle should be allowed to move freely while being directed away from sensitive areas with strategic placements of water and salt licks. Standards for residual dry matter, available in handbooks published by UC Cooperative Extension can be applied at the end of the season. Stocking rates should be based on site-specific conditions. In one instance, a stocking rate of one animal unit/six acres was found to be appropriate for a vernal pool grassland pasture (Jaymee Marty, personal communication). An animal unit consists of a cow-calf. Cow-calf grazing is preferred over yearling grazing (Joe Silveira, personal communication).

At the vernal pool conservation reserves at Sun City (Lincoln) and elsewhere, sheep and goats are used for vegetation management. They also effectively reduce fuel loads and control thatch. The manager of the Sun City reserve felt that the fact that sheep and goats will not enter wet areas was a benefit (Patrick Shea, personal communication). One drawback of using sheep or goats is that they will prefer to eat forbs and broad-leafed herbaceous plants rather than grass.

The choice of grazing animal probably depends on site-specific conditions and land use history. But regardless whether sheep, goats or cattle are used, grazing is preferable to either fire or mowing as well as more feasible to implement for managing fuels and maintaining vernal pool grasslands. Grazing specialists should be engaged to develop specific prescriptions for vernal pool grassland conservation reserve units.

Monitoring and Maintenance

Fuels treatments in all treatment areas and all PCCP vegetation types must be considered long-term management commitments. Initial treatments may be done in stages over time or all at once. After initial treatments are completed, e.g., after completing a shaded fuel break along property lines, the clock starts running until follow-up maintenance is required. Therefore, maintenance should be explicitly addressed within prescriptions.

Monitoring provides the data to determine what maintenance should be undertaken and where and when it should be done. Management plans for conservation reserves, as required by the PCCP, will include procedures for monitoring. Those procedures should address fuels.

Ideally, after initial treatments and some follow-up conservation reserves would be in a state that would be "self-maintaining". That might mean they would be resilient to the effects of fire. If feasible, prescribed fire may have been re-introduced as a natural process. Although this objective might be relevant at some scale and in some locations, it will be impractical for most PCCP conservation reserves. It is more likely that most if not all conservation reserves will require some level of maintenance over time to retain vegetation conditions that ameliorate or prevent wild fire impacts.

For vernal pool grasslands, grazing, limited mowing and disking (outside the vernal pool environment) and selective use of fire will be viable approaches to both reducing fuels and maintaining the reserves. The principal maintenance issues will apply to oak woodlands and riparian woodlands.

In these woodlands, maintenance will mainly involve removing vegetation attempting to re-establish in the treated area (e.g., shoots of sprouting shrubs or trees, seedlings of undesirable species or in undesirable locations, etc.) (Figure 20). This may be done with machinery, by hand with hand tools, with prescribed fire, with herbicides or with grazing or browsing animals. The choice of approach depends on the vegetation community, environmental constraints, costs and other factors.

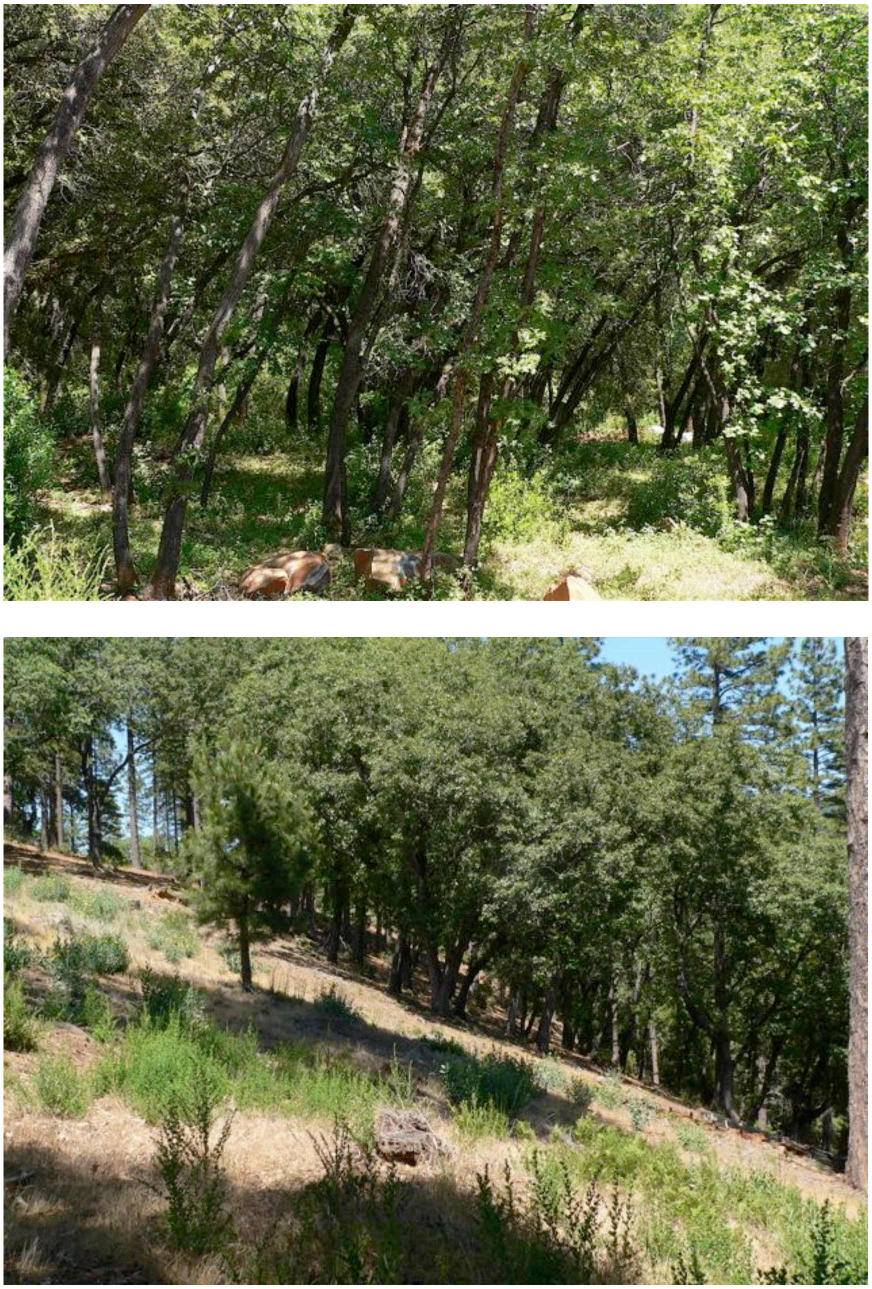


Figure 20: These photographs illustrate oak sprout re-growth (upper picture) and invasion of an opened area by exotic shrubs (broom) in treated areas 1-2 years after initial treatment.

Maintenance will be most important when sprouting oaks or shrubs are present or when opportunities for invasion by exotic plants exist. For example, treatments in live oak woodlands may actually stimulate sprouting and create unfavorable surface fuel loads within a couple of years after treatment. As noted below under “Implementation” costs for maintenance in situations like this can be nearly equivalent to costs for initial treatments especially if hand treatment is required.

Implementation

An important element of the Conservation Plan will be an estimate of costs for implementation. This includes costs for wild fire risk reduction. It is unknown what the annual or periodic magnitude of treatments (acres) will be. It is assumed that vernal pool grasslands will be treated annually with a combination of mowing (at property boundaries), grazing and perhaps prescribed fire. No initial treatments would be required to create a fire-resistant state. Oak woodland and riparian reserves will likely receive initial treatments (shaded fuel breaks, primarily but including parcel-scale treatments) soon after acquisition and will then be maintained at some interval either with animals, manual, chemical, fire or machine treatments.

Below is a cost table that was compiled from a variety of sources. These costs are for treatments only and do not include the costs for designing and permitting the treatments. According to the Placer County CWPP, as of 2008 these costs ranged from $180-250/acre depending on project size (Holl 2008) assuming that environmental clearances include Categorical Exemptions or Mitigated Negative Declarations pursuant to CEQA and that no new road construction is required. All costs assume operations on moderate terrain (slopes generally <30 percent).

The wide range in costs for the same treatment reflects several factors. Low-end costs would apply to treatments conducted with subsidized labor, in readily accessible locations and in less complex fuel conditions. High-end costs apply to treatments conducted by contractors or government employees paid at prevailing wage rates, perhaps in more difficult operating conditions. Another influence on costs is production rates. In relatively simple fuel types (brush) a masticator can operate on 2-5 acres/day (Doug Wickizer, personal communication). Production rates will be lower in more complex fuels. Production rates for manual treatments depend on the size of the crew but generally will be lower than rates using mechanized harvesting.

Costs are not static and it is not likely that fuels treatment costs will decline in the future because of major technological breakthroughs. This should be considered in estimating future costs for maintaining conservation reserves.

Sources of funding for fuels treatments may include grants and/or endowments associated with conservation reserves. In one project managed by the Wildlife Heritage Foundation, conservation reserves within a development are managed with funds obtained from an assessment on residents (Pat Shea, personal communication). In the case of the PCCP, this assessment would have to be levied at the time that fees are collected from developers when they obtain permits.

Table 4: Fuel Treatment Costs ($/acre)

Initial Treatments			
Treatment	**Oak Woodland**	**Riparian Woodland**	**Vernal Pool Grassland**
Mastication (shaded fuel breaks and parcel scale)	$500-3500	$500-3500	N/A
Hand thin/pile and burn or lop and scatter (shaded fuel breaks and parcel scale)	$650-3500	$650-3500	N/A
Maintenance Treatments			
Mastication (shaded fuel breaks and parcel scale)	$500-800	$500-800	N/A
Hand thin/pile and burn or lop and scatter (shaded fuel breaks and parcel scale)	$1500-2000	$1500-2000	N/A
Broadcast burning	$325-1500	$350-1500	$100 (at property boundaries, along roads)
Graze/browse	$400-700	$400-700	$400-700
Mowing	N/A	N/A	$100 (at property boundaries, along roads)
Miscellaneous Treatments			
Chipping (alternative to pile and burn or lop and scatter)	$200-1100	$200-1100	N/A
Pile and burn	$250-700	$250-700	N/A
Pruning	$325	$325	N/A
Herbicide treatments (hand application)	$50-200	N/A	N/A

Notes: costs depend to a large extent on economies of scale since costs for planning, moving in people and equipment or animals, preliminary treatments, etc. are relatively fixed. Sources: Pat Shea, Wildlife Heritage Foundation, Jeff Stephens, CALFIRE, Robert Little, CALFIRE, Ferrier et al (2007), Jeff Webster, Registered Professional Forester, Mike Brenner, NRCS and Holl (2008).

One potential source of revenue would be selling wood derived from fuels treatments. Placer County has a biomass utilization strategy that emphasizes deriving fuels for electricity generation from forestry activities (Placer County 2007). There is a possibility that fuels treatments in conservation reserves could generate materials for power production and be compensated at least in part for treatment costs. Logistic issues that would apply to utilization would include access for chipping equipment and chip trucks, amount of available materials and distance to the power plant. This option should be considered in specific instances where it appears to be feasible.

BEST MANAGEMENT PRACTICES (BMPS) FOR FUELS TREATMENTS

Every conservation reserve will have environmental and ecological conditions that will dictate specialized protection. Therefore, the BMPs described here should be considered a starting point and may be adapted to fit specific areas. Sources of BMPs for fuels treatments include several Fire Safe Councils as well as Biological Opinions on fuels treatment projects on federal lands (Anonymous no date; Anonymous 2008; Diablo Firesafe Council 2008; USFWS 2003).

Certain constraints will apply to some conservation reserves and not others. Vernal pool grasslands are associated with level to undulating terrain where geologic and soil-related hazards will not be significant constraints on fuels treatments. Oak woodland and riparian reserves will generally have a higher level of environmental constraint.

Stream Protection

Prescriptions for fuels treatments in or near streams will include the following BMPs:

- Equipment operations will generally be excluded within riparian zones unless adequate environmental protection can be ensured to prevent adverse impacts on soils and water quality.
- No debris created by fuels treatments will be allowed to enter the channel.
- No vegetation removal will generally occur in the immediate vicinity of channels (core zone). Exceptions may be permitted to control exotic vegetation that contributes to high fuel loads.
- Vegetation removal within the inner zone (up to 100 feet from the channel) is limited to under-story thinning to reduce ladder fuels.
- Species and canopy diversity will be maintained within the inner zone to ensure that ecological functions are protected.
- Stream crossings will generally only be permitted at existing locations. Improperly functioning crossings may be upgraded or re-located during fuels treatments.

Seasonal and Permanent Wetlands

Many conservation reserves will be entirely vernal pool grasslands. Prescriptions for wild fire management in vernal pool grasslands incorporate the following BMPs:

- No equipment operation or herbicide use is permitted within vernal pool topographic depressions.

- Vegetation removal is limited to grasses and other herbaceous species that are not components of the desired vernal pool flora.

In woodland reserves (oak woodland, riparian woodland) there may be inclusions of seasonal and permanent wetlands. CARP provides requirements for avoiding impacts in these wetlands. The general recommendation is that wetlands isolated from streams, flowing springs and seeps have 100-foot buffers wherein disturbance is avoided. In regard to fuels treatments, this would imply exclusion of equipment operation and restrictions on vegetation removal. These wetlands will usually have a low fire hazard unless they have been invaded by weedy exotics such as Himalayan blackberry or brooms. Additional BMPs include the following:

- Fuels treatments in seasonal and permanent wetlands, if any, will be confined to reducing exotic vegetation posing a fire hazard.

- No road or trail crossings through seasonal or permanent wetlands are permitted.

- No dragging of trees or brush through seasonal or permanent wetlands is permitted.

Topography, Geology and Soils

Fuels treatments that would be considered for conservation reserves would rarely trigger concerns over geologic hazards or soil erosion. The operations that could cause concern would be mechanized harvesting on steep slopes or projects involving road or trail construction. The following BMPs would be implemented to reduce potential for soil erosion or mass wasting:

- No equipment operation is permitted on slopes steeper than 50 percent or in areas of known geologic instability except on existing roads.

- To the degree possible, only existing roads and trails will be utilized for access to fuels treatments.

- Erosion control measures, including water bars, silt fence, mulches and re-vegetation with native species will be applied to any action resulting in disturbed soils posing a risk to water quality.

Cultural Resources

Placer County has a rich history and a legacy of cultural resources spanning pre-European times, the Gold Rush era and up to the present. The presence and locations of many of these resources are known but many other resources remain to be discovered. In planning and executing fuels treatment projects, CALFIRE requires consideration of cultural resources including a finding of no significant impacts and/or concurrence on mitigation measures by a CALFIRE archeologist (Snyder 2007). The same standard will be applied to any fuels treatments planned for conservation reserves. The PCCP implementing entity will consult with affected tribal representatives and the State Historic Preservation Office on proposed projects during the CEQA review process. Surveys by qualified professionals may be required to determine if cultural resources are present in a proposed treatment area.

As a general policy, any cultural resources found within conservation reserves will be preserved. If cultural resources could be adversely affected by a fuels treatment, mitigation will consist of avoidance or modified practices e.g., hand treatments as opposed to mechanical treatments. Rarely will protecting cultural resources cause a fuels treatment to be infeasible.

Wildlife (General)

Conservation reserves are created to provide habitats for PCCP-covered species and for other wildlife. Fuels treatments can result in direct impacts on wildlife habitat through removal of vegetation as well as displacement of resident wildlife (Manley 2007). These impacts can be minimized if all habitat components are retained and operations are timed to accommodate species' behavior. Spatial constraints on the sizes of treatments may be imposed to minimize disturbance. Additional mitigation measures may include retaining shrub and ground cover while reducing ladder fuels e.g., separating shrub and ground cover patches from trees, retaining trees that provide roosting and nesting habitat or that are good mast producers and retaining shrub species that provide browse and/or fruits. Large woody debris on the forest floor and snags should also be retained consistent with fire hazard reduction requirements. Restrictions on operations in and around roosting, nesting and breeding sites during specified periods of the year may be required. Typical BMPs will include:

- Fuels treatment operations will be limited during the bird nesting season of March 1-August 31 (best to operate in fall and winter).

- On parcel and landscape scale treatments wildlife travel corridors will be maintained by selective retention of under-story shrub and tree patches.

- Potentially sensitive habitats such as rock outcrops and wetlands will be flagged or fenced prior to treatment implementation.

- Habitat components such as snags and large woody debris will be retained to the degree possible.

- In cases where potentially sensitive or special status species not covered by the PCCP may be associated with habitats proposed for treatments, field surveys may be conducted to determine their presence or absence and appropriate mitigation measures may be required.

PCCP Covered and Other Listed T&E Species (Plants and Wildlife)

The success of the PCCP as a conservation strategy depends on the effectiveness of the conservation reserves in providing habitat for covered species. Incidental take of species is permitted on that basis. Consequently if fuels treatments or wild fire result in habitat degradation or take of covered species, the basis for the PCCP is undermined. To ensure against those effects, the following BMPs will be applied to fuels treatments:

- For all projects, potential occurrence of covered species and other special status plants or wildlife will initially be evaluated through a search of the California Natural Diversity Data Base and other information sources. If special status species are likely to occur, field surveys may be conducted.

- Temporal and spatial limitations on fuels treatments will be applied to avoid impacts on covered species and other special status plants and wildlife. These may include limitations on treatments during nesting and fledging seasons, imposition of buffers on nest sites or other habitat elements such as ponds and wetlands and prohibitions on removing habitat elements such as elderberry patches, nest trees, etc.

BMP Implementation

A California Registered Professional Forester (RPF) or Certified Range Manager (CRM) should be retained to develop fire management prescriptions for conservation reserves. An RPF or CRM should also supervise the work. To ensure that BMPs are properly understood and implemented, contractors or others engaged to do the work will be briefed on environmental conditions and required operational constraints prior to beginning the work. Contracts will include stipulations for BMP implementation and monitoring will be conducted by the RPF or CRM to assess compliance. Penalties may be assessed if contract requirements are violated.

RESERVE FIRE MANAGEMENT PLANS

The PCCP requires that every conservation reserve have a management plan. One component of that plan will address methods to reduce wild fire risk and prevent degradation of reserve quality by fire suppression actions if a fire occurs. The content of the fire management component is outlined below.

- Goals and Objectives for Reducing Wild Fire Risks

- Wild Fire Risk Assessment

- Prioritized Treatments

- Costs and Funding

- Schedule for Implementation
- Maintenance
- Monitoring and Adaptive Management

It is assumed that the overall management plan will provide property descriptions, mapping of sensitive areas and resources, specified locations for treatments, access routes, potential sites for suppression staging, environmental analysis and mitigation measures for proposed land management activities.

There are templates and examples of fire management plans that can be used to guide the PCCP implementing entity (TSS Consultants 2007; Ferrier et al. 2007). One topic that deserves consideration here is the manner in which wild fire risk is assessed.

Wild fire risk assessment can potentially be a highly technical process. CALFIRE Forest and Resource Assessment Program (FRAP) uses modeling to produce generalized maps depicting "fire threat" ranging from moderate to extreme (Figure 21). These maps provide useful snapshots at the landscape scale but may not be adequate for parcel-level evaluations (David Sapsis, personal communication).

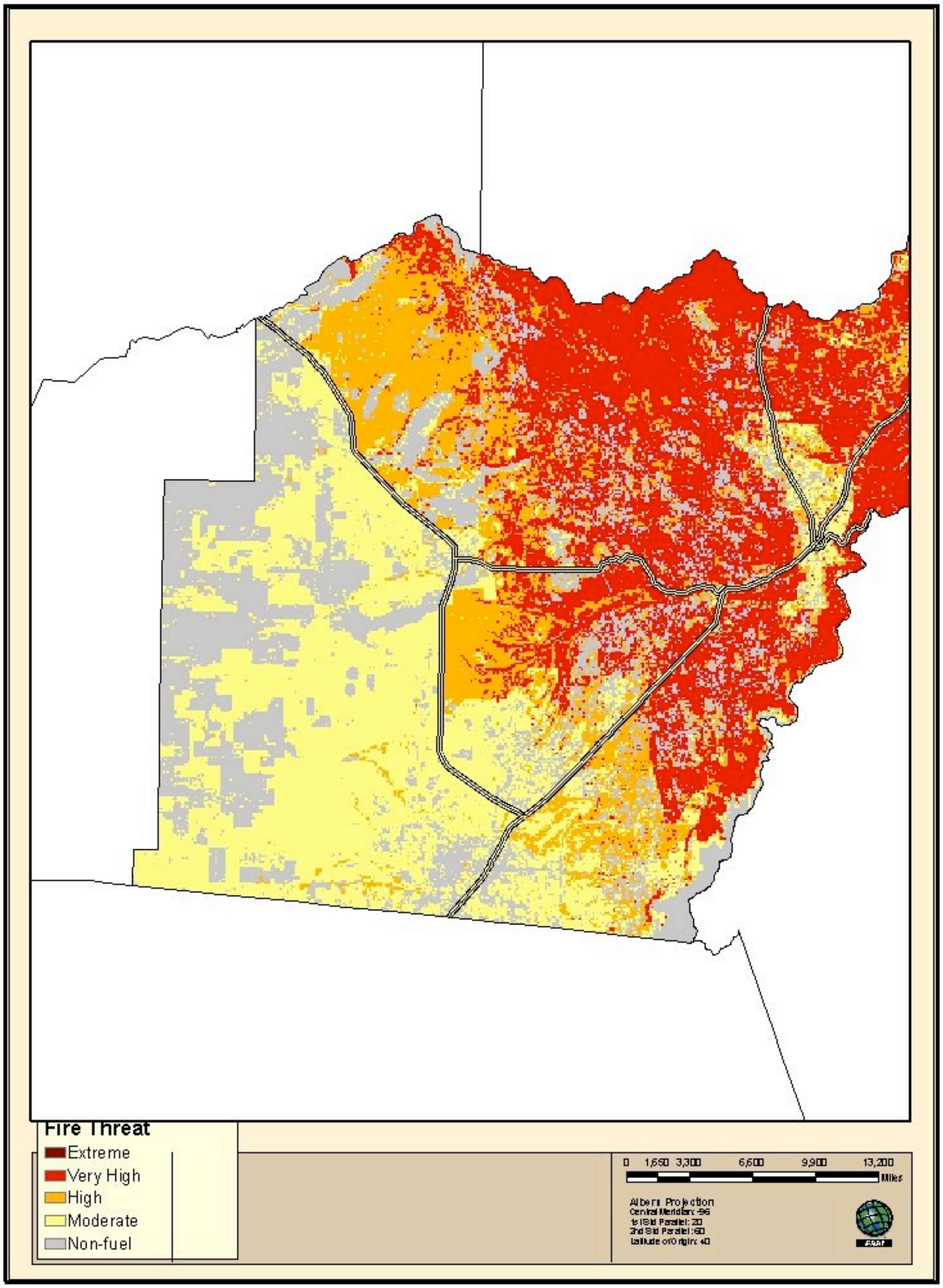


Figure 21: The above map is an example of "fire threat" maps produced by FRAP. It covers the PCCP planning area and beyond to Foresthill. Vernal pool grasslands are generally mapped as "moderate" threat and oak woodlands are mapped as "moderate" to "very high".

Several land management agencies have identified a need to obtain higher resolution fire hazard mapping for their properties. Some have used FlamMap (available at www.fire.org/tools) to map fire hazard on their properties. As with most fire behavior models, FlamMap utilizes data on fuels, weather and topography to provide spatially explicit fire hazard maps. The results of modeling with FlamMap or similar models include spatial distribution of flame lengths (an important determinant of fire suppression strategies), crown fire potential and rate of spread. These predictions can be extremely useful for planning and prioritizing fuels treatments. Finney (2001; 2004) used FlamMap to develop simulations for strategic placements of fuels treatments and to hypothesize effective spatial patterns.

PCCP conservation reserves will be acquired over time. Although the general area where they will be acquired or where conservation reserves already exist is known, it is not possible to predict what the ultimate reserve pattern will be. Consequently, it is likely that fire risk assessment will be conducted on a parcel-by-parcel basis as properties are acquired. Modeling fire hazard at the parcel scale may not provide sufficient information for designing or locating specific treatments (Jessica Pierce, personal communication). The rationale for parcel-specific modeling would be based on the presence of critical resources such as housing tracts or infrastructure that could be affected by fire. In the absence of those resources, professional judgment of experienced managers along with existing data on fuels, topography and other conditions may suffice for fire risk assessment on conservation reserves.

In the future if a CWPP is prepared for the PCCP planning area, modeling might be employed to evaluate alternative treatment strategies at the landscape scale. There is potential for a compatible relationship to develop between conservation planning and wild fire management. For example, conservation reserves that are treated to reduce fuels could provide the framework for wild fire protection throughout western Placer County.

SUMMARY AND CONCLUSIONS

- At the present time, there are over 11,000 acres of vernal pool grassland, oak woodland and riparian woodland within conservation reserves in western Placer County. These properties are managed by several public, private and non-profit entities. When the Placer County Conservation Plan is fully implemented, the area of conservation reserves will increase by approximately 50,000 acres.

- Wild fire presents a significant threat to the sustainability of current and future conservation reserves. Wild fires that may start on conservation reserves pose a threat to adjacent properties.

- The risk that a fire will affect a conservation reserve and the potential severity of a fire are determined by several physical, climatic and biological factors. From a management perspective, the principal thing that can be done to reduce wild fire risk is to reduce fuel loads. Reducing fuel loads can affect the rate and direction of fire spread and the severity of a fire.

- In regard to the vegetation types within conservation reserves, oak woodlands have the highest inherent wild fire risk. Overly dense riparian woodlands are second in degree of risk. Vernal pool grasslands have a relatively lower risk because only one fuel type is present (generally no shrubs or trees), terrain is moderate and the vegetation is adapted to fire.

- Several approaches are used to reduce fuels. The choice of approach is affected by environmental constraints, costs and other social and ecological considerations. The highest priority in conservation reserves is to protect the habitat they provide for covered species. Any fuels treatment must meet this requirement.

- Fuels treatments are aimed at preventing or at least impairing the spread of a fire and reducing fire severity. Fuels treatment zones include property boundaries, public roads and the interior of reserve parcels. In oak woodland shaded fuel breaks may be used along roads and at property boundaries and within parcels to impair fire spread. Fuel breaks can be used at the periphery of vernal pool grasslands. Fuels treatments in riparian woodlands should focus on the interface between the upland and riparian vegetation.

- Oak woodland and vernal pool grasslands can be managed on a parcel or landscape basis to reduce fire risk. In woodlands, strategic fuels treatments to reduce ladder fuels would be appropriate. Grazing and limited prescribed fire is recommended for vernal pool grasslands.

- Fuels treatments will only be effective if they are followed up by periodic maintenance. This is most important in oak woodlands where rapid re-growth of woody vegetation is possible.

- Fuels treatments can be costly. Implementation of a fuels treatment program for the PCCP conservation reserve will depend on the ability of the implementing entity to procure funds.

- Best management practices must be included in fuels treatments to prevent or minimize impacts on streams, cultural resources, wetlands, soils, wildlife and PCCP-covered or other special status species. The strategy should emphasize avoidance of impacts.

- Every conservation reserve will have a management plan. Wild fire management should be a component of that plan. Although modeling methods exist for fire management planning, these may not be feasibly applied on a parcel-by-parcel basis. Instead, professional judgment and efficient use of existing information may be used for fire management planning.

- If a CWPP annex is prepared for the PCCP planning area, there is the possibility that conservation planning and wild fire management can be coordinated to create an overall optimal land use pattern.

- If a wild fire occurs within a conservation reserve it is important that provisions are in place to minimize environmental impacts of suppression activities (see Addendum 1). These are generally termed “minimum impact suppression tactics”.

ACKNOWLEDGMENTS

Several individuals provided substantive comments on drafts of this report. Their comments and suggestions made the final product better. Reviewers included Miriam Merrill, US Fish and Wildlife Service, Lorna Dobrovolny, Department of Fish and Game, Matthew Reischman, CALFIRE, Ryan Bellanca, Placer Resource Conservation District, Karina Silvas, Sierra Forest Legacy, Jessica Pierce, Placer Land Trust, Doug Ferrier, Registered Professional Forester and Andy Fisher, Placer County Parks Division. In addition, the Board of Forestry Range Management Advisory Committee provided comments on the guidelines at several of their meetings. The Placer County Resource Conservation District, Forestry and Fire Committee also provided suggestions particularly on costs of fuels treatments.

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ADDENDUM 1

WILD FIRE SUPPRESSION IMPACTS

When a wild fire occurs, fire-fighting strategy depends on several goals. For most fires in the wildland-urban interface, preventing the spread of fire to houses, commercial facilities and infrastructure will be the highest priority. A second tier of priorities may include preventing damage to valuable natural resources such as timber. On occasion a high priority may be assigned to protecting biological communities with intrinsic ecological worth.

For conservation reserves situated near urban or rural residential development, suppression attack will be more aggressive than for reserves in remote locations. Aggressive suppression tactics in turn can cause both short- and long-term environmental and ecological damage. The effects of suppression can change the character of conservation reserves to the extent that they no longer serve the purposes for which they were acquired. The duration of suppression impacts depends on many things including resiliency of the vegetation, degree of damage to site conditions and actions taken to rehabilitate and restore the vegetation.

Fire suppression methods include the construction of fire lines, back burning, application of water from pumps or aerial drops, the use of fire retardants and suppressant foams, construction and use of helicopter landings, material storage and refueling areas, and fire camps (USDA Forest Service 2006). Potential environmental effects of these activities include increased erosion and mass wasting (landslides) from fire line construction, destruction of vegetation, contaminating streams, lakes and wetlands and wildlife harassment.

Fire retardants and foams are known to be toxic to aquatic species. They are typically applied to ridge top vegetation and adjacent to natural fire barriers such as roads, meadows, and rock outcrops. The risk to aquatic species is therefore relatively low. In cases where endangered aquatic species are involved, application of retardants and foams may be restricted within 300 feet of surface waters (USFWS 2003). Current CALFIRE guidelines stipulate that aerial applications of retardants be limited to areas >300 feet from water courses and that ground applications be prohibited within 100 feet of water courses (CALFIRE 2007).

Clearly the most significant damage to natural resources due to wild fire suppression is caused by activities such as fire line construction, back burning and encampments (Figures 1A and 1B). Fire line construction in steep terrain can result in the removal of large swaths of vegetation and soil disturbance over a large area.

Figure 1A: Fire line construction with bulldozers can result in short and long term environmental impacts particularly if potential fire lines have not been designated in advance.

Figure 1B: The practice of “back burning” to a fire line to prevent further spread can result in “collateral” damage to large habitat patches.

Other potential effects of suppression include the potential for introducing exotic plants and/or pathogens on machinery and equipment or during rehabilitation efforts.

BEST MANAGEMENT PRACTICES FOR WILD FIRE SUPPRESSION ACTIVITIES

Wild fire suppression impacts in conservation reserves can be limited through implementation of "minimum impact suppression tactics" (MIST). Although developed initially for wilderness areas, MIST procedures have application to any areas with important ecological and environmental values (USDA Forest Service 2006). They pertain to location of camps and helispots, construction of fire lines, protection of resources during suppression and fire fighter behavior. A key source of information on MIST is www.wilderness.net in "Toolboxes" under "Fire Management" (Arthur Carhart National Wilderness Training Center 2008). Additional information on MIST is included in USDA Forest Service (2006). It provides guidance for response to wild fire on National Forests but many of the concepts are applicable to wild fire on any lands. According to that document MIST is "any of a wide range of actions to minimize the appearance of suppression tactics". MIST is to be considered "in wilderness, wilderness study areas, or scenic areas…in or near trails, recreation areas or other areas of high concern" provided that implementation "does not compromise chances of success."

To ensure implementation of MIST during an event within a conservation reserve, the PCCP managing entity should provide mapped information to CALFIRE and fire fighting organizations for each conservation reserve that displays, at the minimum: 1) pre-determined fire lines; 2) fuel treatments; 3) potential staging areas, helispots and camps; and 4) key resources e.g., wetlands, habitats for covered species, known areas of instability, cultural sites, etc. The incident commander can use this information to direct suppression actions. Annual meetings should be held to update CALFIRE on new acquisitions, the status of reserve management and changes in management due to monitoring and adaptive management. Operational meetings should be held annually to inform new personnel about the reserves and appropriate suppression tactics.

The California Department of Parks and Recreation (DPR) has worked with CALFIRE, which acts as its fire department, to implement MIST (Richard Adams, personal communication). Standard language in DPR wild fire management plans includes:

- Use MIST to extent feasible without compromising firefighter or public safety.
- Include DPR resource advisor during (suppression) planning and strategy sessions.
- Discuss MIST during briefings and ensure MIST implementation.
- No motor vehicles driven off paved or dirt roads in meadows and riparian areas.
- No bulldozers in sensitive resource areas.
- No fire retardant drops in the vicinity of lakes, meadows, and riparian corridors.

- Consider use of natural barriers and cold-trailing.

- Minimize cutting of trees, burned trees, and snags.

DPR advises compartmentalizing reserves into logical units bounded by roads, trails, ridges, water courses, barren areas, fuels treatments or other non-sensitive areas where fire line construction is acceptable. Under favorable weather conditions, a fire can then be allowed to burn to those boundaries and avoid bulldozing through a sensitive area. Compartments immediately adjacent to developed areas will require aggressive direct fire attack. Protection of life and property always takes priority over protection of resources (Richard Adams, personal communication).

Some additional considerations include:

- Outline and map emergency access routes.

- Minimize use of heavy equipment for fire line construction e.g., utilize "wet fire lines" and hand-built lines" where practicable.

- Avoid back firing through sensitive habitats.

- Require post-fire rehabilitation to mitigate potential impacts of suppression actions. Ensure that post-fire rehabilitation efforts do not adversely impact ecological conditions e.g., through introduction of exotic plants.

For further information on fire suppression impacts and methods to avoid them consult www.fusee.org, the website for Firefighters United for Safety, Ethics and Ecology (FUSEE).